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BEHRENS (J.). **Die Perithecien des Eichenmehltaus in Deutschland.** [Perithecia of Oak Mildew in Germany.]—*Zeitschr. für Pflanzenkr.*, xxxi, 3–4, pp. 108–110, 1921.

In October, 1920, the writer discovered the perithecial stage of the oak mildew near Hildesheim (Hanover). This is the first time the perithecia have been observed in Germany. They were restricted to one single leaf.

They were compared with those found by Arnaud and Foëx in France, in 1911 and considered to be identical by Neger. The fungus is identified as *Microsphaera extensa* Cooke and Peck (*M. quercina* (Schw.) Burr.), which has been united by Salmon with *M. alni* (Wallr.) as *M. alni extensa* (Cooke and Peck) Salm.

TRAVERSO (G. B.). **La forma ascofora dell' oidio della Quercia a Roma.** [Ascus stage of Oak Oidium in Rome.]—*Boll. mensile della R. Staz. di Patologia vegetale*, ii, 1–4, p. 35, 1921.

The author reports that Peyronel has discovered numerous perithecia of the oak mildew, which first appeared in Europe in 1907, near Rome, and has, in agreement with Peglion, Arnaud, and Foëx, identified it as *Microsphaera quercina* (Schw.) Burr. Peyronel considers that the conidial form occasionally met with on the oak in Italy, Portugal, and Switzerland prior to 1907, belonged not to this fungus, but to *M. alni*. He maintains that cold is only a contributory factor in the formation of the perithecia, the chief cause being dryness or, rather, the excessive transpiration of the fungus in relation to a scarcity of nutrient juices obtainable from the host.

KRISTOFFERSEN (K. B.). **On the Relation between Sugar Content and Winter Rot in the Garden Carrots.**—*Botaniska Notiser*, iv, pp. 149–163, 1921. (English.)

Samples of commonly cultivated carrot-roots were taken by boring average roots, and the sugar content determined polarimetrically. The results showed that different cultivated kinds varied considerably in their sugar content, the variety known as

'St. Valery' having the greatest excess of cane sugar, 'Guérande' being next, and 'Nantes' still lower, while in 'Parisian' invert sugar was in excess.

During the winter the bored roots were kept in a cellar, and when examined in the spring all the roots of Parisian carrot and Nantes were found to be rotten, as was also the case with most of the Guérande, but most of the St. Valery variety had wintered well, only a few being rotted. Thus St. Valery, which had the greatest excess of cane sugar, was the most resistant sort, Guérande was intermediate, while Nantes and Parisian carrot, with a slight excess of cane sugar and of invert sugar respectively, showed poor resistance. This pointed to a certain relation between the cane sugar content and the resistance to winter rot, but gave no information in regard to the percentage of total sugars.

In the winter of 1920–1 further investigations were made with the same varieties, there being two stocks, (A) and (B), of each of the varieties St. Valery and Nantes. A number of typical roots of each of these sorts was placed in sand in the cellar, and an average sample was prepared from each sort for more detailed analysis, the rest being left to test resistance to rot. The methods of analysis employed are described in detail, special attention being directed to avoiding possible sources of error in the determination of the quantity of reducing sugar present.

Summarizing the results of the sugar analysis and of the rot resistance, the difference between the percentages of total sugar in the individual varieties was found to be relatively insignificant. Thus the percentage of total sugar in Parisian carrot was 6·90 and in St. Valery 8·13, the other varieties being intermediate. The variation in the invert sugar was proportionally greater; in Parisian carrot the percentage was 4·53 and in St. Valery 2·43. The resistance to rot varied greatly, the poor resistance of Guérande (84·6 per cent. of rotten roots) being remarkable. This variety is generally superior to Nantes in the matter of resistance, but in the case in point Nantes (A) had only 33·3 per cent. of rotten roots, while (B) (an improved race) had but 7·1 per cent. St. Valery (A) had 26·9 per cent. and (B) 5 per cent. of rotten roots.

No correlation could be established between total sugar present and rot resistance. On the other hand, there was a decided connexion between the amount of invert sugar and resistance: the lower the percentage of invert sugar the greater the resistance. The correlation became more marked if, instead of considering the total percentage of invert sugar, its relative percentage in regard to the total sugar was taken.

The critical point in rot resistance appears to be located at a relative percentage of invert sugar to total sugar of about 45 to 50 per cent.; that is to say, the roots will probably rot during the winter if they have more than half the cane sugar inverted at the beginning of storage. Among 39 individual roots analysed by taking a boring and then, after covering the bore-hole with sulphur, placing them in sand to test their rot resistance, only three form exceptions to this rule, all belonging to the variety Guérande. More than half the cane sugar was inverted in these three, but they wintered well. Possibly the anatomical structure

of the roots of this variety, which differs from the others, may be responsible for these departures from the rule.

It is evident from these data that carrots contain both cane sugar and a reducing sugar, here termed invert sugar. The writer has made no attempt to determine the exact nature of the latter, and states that there are very few references to it in the available literature. Dextrose has been reported to be contained in carrots by König, while Hellweg, like the writer, calculated the reducing sugar as invert sugar.

It has been stated by other workers that cane sugar is inverted considerably during the winter in *Beta*, and that a correlation exists between the percentage of cane sugar and invert sugar in the beet, which is not apparent in carrots.

The investigations made give no information as to the physiological connexion between greater or lesser ease of the inversion of cane sugar, and greater or poorer rot resistance. Probably the invert sugar is a better nutrient for the bacteria involved in rotting than cane sugar.

The practical application of the results of these experiments should lie in the determination of the proportion of invert sugar in carrots, in order to select varieties likely to prove resistant.

DUCOMET (V.). **La Résinose du Topinambour.** [Resinosis of Jerusalem Artichoke.]—*Bull. Soc. de Path. Vég. de France*, viii, 2, pp. 64-65, 1921.

A disease, apparently not previously described, was found in specimens from the Aude Department, France. Sections of the tubercles showed rusty yellow areas of variable size, from a pin's head to 2 to 3 mm., or rarely 7 to 8 mm. in diameter. These spots form a regular network, affecting the greater part of the tubercle, from the phloem to the medulla. The coloured matter is friable, having the aspect and consistency of powdered resin. Even when cooked the tubercle has a bitter taste, and cattle feed on it with repugnance.

The disease seems to have affected plants grown from local tubers only; those grown from tubers imported from other departments appear to have escaped, except when mixed with local kinds. When, however, the introduced kinds were planted in the immediate vicinity of home-grown varieties, and in the direction of predominating winds, they became attacked, thus suggesting a contagious disease.

A preliminary study of the data has led the author to the conclusion that this disorder is an excessive secretion of oleo-resin—normal in the case of the Jerusalem artichoke and allied plants—and a subsequent modification of the secreted product (oxidation most likely). Heating dry, or in water or lactic acid, reduces the resinous, coloured concretions to small, ultimately colourless globules, that fix Sudan with energy. As soon as these excretions disappear, irregular lacunae are seen, surrounded by large, more or less dislocated cells, having very large nuclei, and quite distinct from the normal parenchyma. These lacunae form knots, as it were, in the normal secretory network found in healthy tubercles, especially in the fibro-vascular ring. Only very slight and rare

traces of this disease have been found in the Grignon and Lot-et-Garonne districts, but severely attainted tubercles were met with by the author twenty-five years ago in the sandy soil of the Landes. Both then and now the fact has been noted that affected plants show no symptoms whatever above ground.

The condition is of biological as well as practical interest, since it will perhaps swell the list of 'degeneration diseases', the nature of which is problematical.

MURPHY (P. A.). **The Presence of Perennial Mycelium in Peronospora schleideni Unger.**—*Nature*, cviii, p. 304, 1921.

The assumption that, because the onion mildew fungus—*Peronospora schleideni* Unger—produces its sexual organs in the leaves of the host plant, it is dependent on its oospores for perpetuation from year to year, is shown by the author to be erroneous, as the non-septate mycelium is capable of a perennial existence in the bulbs, and the shoots produced therefrom carry infection *ab initio.* It was found impossible to induce the fungus to fruit on the bulb scales of infected bulbs examined, to infect other onions, or to grow on artificial media. The whole structure of the mycelium is plainly visible without staining, the hyphae being stout and well differentiated from the cells of the host plant, into some of which large convoluted haustoria extend. Where green leaves were present, the mycelium could be traced from the bulb to the apical portion of the leaf on which conidiophores of *P. schleideni* were being produced. In one particular plot, badly mildewed in 1920, almost 66 per cent. of the smaller-sized onions contained non-septate mycelium, and such infected bulbs sprouted prematurely, but the fruiting stage of the fungus was not reached in the greenhouse under winter conditions, though the mycelium grew up with some of the shoots.

Further proof of the relationship of this fungus to *P. schleideni* was obtained in an experiment in which bulbs of *Allium cepa* and of *A. ascalonicum* containing non-septate mycelium were grown (in the early spring) under conditions excluding external infection. In contrast to numerous control plants, which were originally free from mycelium and remained free from mildew in spite of lengthy exposure to conditions favourable to infection, the diseased plants, placed under a bell-jar for one night, were found almost totally covered with mildew the next day. Occasionally shoots, replacing the originally infected leaves which had been cut away before mildew became apparent, were found to be permeated with the mycelium and again developed mildew under favourable conditions. Non-septate mycelium has been observed in the bulbs of the common onion, the shallot, and the potato (or underground) onion, its connexion with the mildew fungus being definitely established in the case of the first two varieties. It survives in infected bulbs left in the soil during the winter, and there is a time, generally in April, when the mildew is found only on plants whose bulbs and leaves are pervaded by it. These plants appear to act as important centres of infection.

A nice balance is preserved between host and parasite, both flourishing side by side for a considerable period, until at a certain stage in the maturity of the leaves the conidiophores are developed,

and even then the host tissue is not destroyed for a long time. When the tips of the leaves turn yellow and droop, mildew breaks out, under favourable weather conditions, at first just below the withered portions of the older leaves, and then spreads to all the other leaves except the youngest.

Other points in this phase in the life-history of *P. schleideni*, including the effect on the keeping qualities of infected bulbs, are still awaiting investigation.

LEHMAN (S. G.). **Soft rot of Pepper fruits.**—*Phytopath.*, xi, 2, pp. 85–87, 1921.

A disease of sweet peppers (*Capsicum annuum* var. *grossum*), in which the fruit rapidly rots, was found in North Carolina. It is attributed to *Pythium de Baryanum* Hesse. Artificial infection was found to be difficult to produce. The natural attack always begins at the blossom end of fruits, not more than 6 or 8 in. above the ground, and is believed to result from zoospores, splashed from the ground by rain, which infect through wounds caused by insects.

COONS (G. H.) & NELSON (R.). **Celery Yellows.**—Abs. in *Phytopath.*, xi, 1, p. 54, 1921.

The disease, characterized by stunting, yellowing, and thickening of the foliage, is found to be due to an undescribed species of *Fusarium*. It was first discovered at Kalamazoo, Michigan, in 1914, and has increased until practically all soil in the vicinity of that city can no longer grow the susceptible variety Golden Self-blanching. It occurs in other parts of the United States. The so-called green varieties do not suffer much from yellows.

POOLE (R. F.). **Recent studies on Bacteriosis of Celery.**—Abs. in *Phytopath.*, xi, 1, p. 55, 1921.

The organism causing the bacterial celery rot in New Jersey was found to be *Bacillus carotovorus* Jones or *B. apivorus* Wormald, which are probably strains of the same organism. The green varieties are only slightly susceptible. Sowing before May 15 reduces loss, the temperature at this time not being favourable to the bacillus.

NISHIKADO (Y.). **On a Disease of the Grape-cluster caused by Physalospora baccae Cavara.** (In Japanese: Author's summary in English.)—*Annals Phytopath. Soc. Japan*, i, 4, pp. 20–41, 1 pl., 1921.

Studies of the causal organism of the disease of the grape-cluster here described (chiefly on the morphological characters of its pycnidium, pycnospore, perithecium, ascus, and ascospore) were carried out during 1914–16.

In the Okayama prefecture and other places where *Vitis vinifera* is cultivated, the disease has been prevalent for about ten years. It affects the peduncle, pedicel, and berry, but not the leaf or stem. The pycnidial stage of the fungus is identical with *Macrophoma reniformis* (Viala & Ravaz) Cavara, known as the cause of black rot in the Caucasus. Its perithecial stage agrees with *Guignardia*

baccae (Cav.) Jaczewski (the perithecial stage of *Macrophoma reniformis*), except for the existence of paraphyses among the asci in the Japanese fungus. The name *Physalospora baccae* Cavara, changed by Jaczewski to *Guignardia baccae*, has been adopted by the writer because of the existence of these paraphyses in the perithecia.

The fungus flourishes on cultural media such as boiled potato or rice, developing copious black aerial mycelia, and occasionally producing pycnidia. The latter do not resemble externally the pycnidia found on the host, though the pycnospores are very similar.

The author's inoculation experiments have so far been inconclusive, but the parasitism of the fungus has been fully demonstrated by previous workers.

BEACH (W. S.). **A Phytophthora crown rot of Rhubarb.**—Abs. in *Phytopath.*, xi, 1, p. 55, 1921.

An undescribed *Phytophthora* producing conidia and oospores abundantly in culture was found to cause the rot. Inoculations were successful. Secondary fungi may complete the decay. The disease becomes severe in wet weather in late summer, and has caused the sudden death of considerable areas in rhubarb fields in Pennsylvania, usually in those recently set, having poor drainage, or receiving heavy manuring. With the return of dry weather many plants recover in part.

BOURNE (B. A.). **Fungoid Attacks reported or observed.**—*Rept. of the Dept. of Agric. Barbados*, 1920–21, pp. 10–11, 1921.

SUGAR-CANE. Root-disease still continues to cause heavy losses. The exact cause of the disease has not yet been definitely ascertained, especially since recent work indicates that it is doubtful if *Marasmius sacchari* Wakker has any parasitic connexion with the root-system of the sugar-cane. The writer has several times isolated a species of *Rhizoctonia* from cane-roots showing typical symptoms of disease, and is of opinion that the latter fungus is largely responsible for the condition. Proper tillage and drainage are essential, and only healthy cuttings should be planted. Other fungi observed were: *Colletotrichum falcatum* and *Cephalosporium sacchari*, associated with red rot; *Thielaviopsis paradoxa*, causing pineapple disease; *Cercospora vaginae*, responsible for a red spot of the leaf-sheath; and *Leptosphaeria sacchari*, the agent of ring spot of the leaves.

SUDAN GRASS (*Holcus sorghum sudanensis*). A typical leaf-disease was caused by *Colletotrichum lineola*, which produces reddish blotches and gives a scorched appearance to the leaves.

CASSAVA (*Manihot* sp.). Specimens of tubers stated to be affected by a rotting disease were submitted for examination, and found to be attacked by a *Gloeosporium*. The conidia extruding from the acervuli formed globular pustules. Spores in mass are greyish white, or with a roseate tinge, sometimes spherical or cylindrical but mostly elliptical, hyaline, 1–2 guttulate, 4–12 by 3–4·5 μ. The tubers showed signs of punctures, and the fungus is evidently a wound parasite causing rot. All diseased portions should be burnt.

CARROT (*Daucus carota*). A softening of the external part of the root was presumed to be caused by *Bacillus carotovorus*.

MANGO (*Mangifera indica*), ELDER (*Sambucus canadensis*), and GARDENIA (*Tabernaemontana*), were attacked by *Diplodia cacaoicola*.

DATE PALM (*Phoenix dactylifera*) was severely attacked by *Graphiola phoenicis*, which destroyed the lower leaves.

TROST (J. F.) & HOFFER (G. N.). **Kernel starchiness as an index of susceptibility to root, stalk, and ear rots of Corn.**— Abs. in *Phytopath.*, xi, 1, p. 33, 1921.

Starchy ears of certain dent varieties of maize were found to produce plants more susceptible to *Fusarium* injury than are plants from ears more horny in composition.

MELCHERS (L. E.). **Ecologic and Physiologic notes on Corn smut (Ustilago zeae).**—Abs. in *Phytopath.*, xi, 1, p. 32, 1921.

The writer reports evidence that there are physiologic differences in culture of *Ustilago zeae* from different isolations. They vary in virulence, and this may possibly account for the varying resistance of selected strains of corn to smut in different localities.

MITRA (M.). **Morphology and parasitism of Acrothecium penniseti n. sp. (A new disease of Pennisetum typhoideum.)**— *Memoirs Dept. Agric. India*, Bot. Ser., xi, 3, pp. 57–74, 4 pl., 1 fig., 1921.

A parasitic species of *Acrothecium* is found commonly on *Pennisetum typhoideum* (vern. bajra) over a large area in North and Western India. It affects the growth of the plants and the production of sound grains, but as yet there is no definite information as to the actual amount of damage caused, though this seems to be considerable. It attacks the leaves, leaf-sheaths, and ears; as it is most common on the leaves the author suggests that the disease caused by it be called leaf-spot or leaf-blight of bajra.

Infected leaves show small, yellowish-brown spots, which gradually increase in length and become oval or oblong. Soon the centre of the spots assumes a dirty brown colour with a yellow margin around it. They are most frequent towards the edge of the leaf, and when situated near each other they soon unite, causing large patches, killing the tissues along the margin of the leaf, and gradually extending towards the midrib. Frequently both margins are affected, and the whole leaf is gradually killed. The spots occur on the midrib also, especially in young leaves, and, in severe cases, even on the leaf-sheaths. The infected portion becomes brittle with age. The disease begins from the lower drooping leaves, starting from the tips which either touch the soil or are very near to it, and then spreads and attacks the upper leaves. The spread of the disease is facilitated by the moisture which the tip and margin of the leaves retain on account of their being slightly upturned. At Pusa, in 1919, the disease made its appearance in June, starting on the lower half-dead leaves of young plants.

The ears can also be attacked. The infection begins from the

tip of the floret and spreads gradually to the whole of the spikelet, and thence to those in the neighbourhood. In a badly-infected ear very few normal grains are formed. An infected flower shows a tuft of black mould at its tip, and mycelium in the ovary, glumes, and paleae.

The mycelium is both intra- and inter-cellular, and is found in all parts of the diseased tissues, even in the cells of the endodermis, sclerenchyma, and vessels. It consists of septate hyaline hyphae, which turn brown at the points where conidiophores are produced. Haustoria are not present. Conidiophores are most numerous in the central dead portion of the spot, issuing from the stomata, and gradually decrease in number towards the margin. They are amphigenous, solitary, fasciculate, rigid, erect, and straight or slightly nodulose or bent. Usually they are simple but occasionally forked near the tip. In colour they are olive brown to dirty brown with paler tips which are either swollen or flexuous. The base sometimes is also swollen. They are 68·4 to 154 μ long and 5·8 to 8·7 μ broad, and have three to five septa. The conidia are clavate, pear-shaped, or elongated, straight or slightly bent, thick-walled, 2–3 septate, and light olive brown to dirty brown in colour. The middle cell is broader and darker than the end cells. They are constricted at the septa, and are borne at the tip of the conidiophore in groups of two to five. Very rarely conidia are noticed on the sides of the conidiophore below the tip. They measure 25 to 41·8 μ by 12·5 to 20 μ.

The fungus was grown on a large number of media in pure culture, and numerous experiments have shown that in such cultures germination is usually rapid and the mycelial growth copious. In some media the spore production is free, and in others scanty, the conidia produced being slightly smaller than those found on the host plant. Chlamydospores are formed in most of the cultures; the cells of a hypha swell up singly or sometimes in a long line, become spherical or oval in shape, develop a thick wall, and, as the culture grows old, turn brown or greyish-brown in colour. These chlamydospores either remain united in a chain or separate, and germinate readily, giving rise to new hyphae. The results of a series of experiments show that the fungus prefers a reaction ranging between +5 and +10 Fuller's scale, but can withstand a considerable range either way.

Formal proof that *Acrothecium penniseti* was the cause of the disease was obtained. The fungus is constantly associated with the disease and was isolated from typical diseased tissues of the host; healthy plants inoculated with pure cultures gave characteristic signs of the disease. Altogether 106 inoculations on leaves (both sides) and leaf-sheaths, together with forty on ears, were made by the author, and all were successful. The fungus was re-isolated from inoculated diseased spots and re-inoculated on healthy plants, and the disease was produced as before. The re-isolated fungus was compared in culture with the fungus used for inoculation and was identical with the latter.

The fungus infects its host through the stomata and also by piercing the epidermis. The host-cells are killed in advance of the mycelial growth, and penetration of the dead cells is evidently

easier than of the living, since in the central dead portion of the spot hyphae are found abundantly, while they are almost absent in the cells towards the margin.

Cross-inoculations failed with *Andropogon sorghum*; they succeeded on the male inflorescence, but failed on the leaves, of *Zea Mays*.

KESSLER (B.). **Zum Auftreten der Federbuschsporenkrankheit in der Rheinprovinz.** [Appearance of the 'Plumed Spore' disease in the Rhine Province.]—*Nachrichtenblatt für den deutschen Pflanzenschutzdienst*, i, 4, p. 28, 1921.

This disease, the appearance of which has been reported in the district of Rheinbach near Bonn, in Rheinhessen, and Baden, is supposed by the author to have been introduced with straw from France, either at the retreat of the German armies or during the present occupation of the territory by the French. Its spread indicates that it has been present for one or two years.

In the Rheinbach district the parasite (*Dilophospora graminis*) attacks both wheat and rye, and neither the composition of the soil nor the nature of the fertilizers employed seems to have any influence on its appearance. The extraordinary drought of 1921 does not appear to have stopped the development and spread of the fungus, and Schaffnit has observed it in Rheinhessen, which suffered particularly from the drought.

In judging the extent of the damage done by the disease, it should be borne in mind that generally only about 5 per cent. of the diseased spikes grow out of the leaf-sheaths and reach the normal height. By far the greater proportion of affected plants are therefore not noticed at all on a cursory inspection, and the estimate of the damage is likely to be too low.

The peculiarly plumed spores of the fungus are pycnospores. The pycnidia lie in rows, completely buried under the epidermis, in a thick, felted, white bedding of mycelium. Their walls are of a dark olive-green colour, and the interior is filled with a mass of spores, almost horny when dry, but becoming gelatinous when moistened, and protruding out of the mouth of the pycnidium in a worm-like mass.

The germination of the spores is peculiar. A septum is formed in the middle, and both halves of the spores swell up until, when they have reached a certain size, they break apart at the septum. Each half, or sometimes only one of them, then puts out a germ-tube in the direction of the axis of the spore. The two halves may remain in contact or separate during germination.

According to Fuckel, perithecia are developed on plants attacked in autumn and during the winter, but whether this perithecial form, described by Fuckel under the name of *Dilophia graminis*, is the perfect stage of *Dilophospora graminis* has not yet been conclusively proved. The point is of importance in checking the disease, for while it is easy to free the grain from pycnospores by disinfection, it will be much more difficult to control the disease if it is caused by ascospores, as these can winter over on fragments of straw or stubble which remain in the field.

VAN DER BIJL (P. A.). **On a Fungus—Ovulariopsis papayae n. sp. —which causes Powdery Mildew on the leaves of the Pawpaw plant (Carica papaya Linn.).**—*Trans. Roy. Soc. S. Africa*, ix, 2, pp. 187–189, 1 pl., 1 fig., 1921.

The under surface of the leaves of pawpaw along the coast of Natal is often found to be covered with blotches of a powdery mildew, which sometimes spreads over the greater portion of the surface. No previous records of a powdery mildew on the leaves of the pawpaw seem to exist, and it is held to be a new species for which the name *Ovulariopsis papayae* is suggested. The writer gives the morphological description of the genus *Ovulariopsis* as founded by Patouillard and Hariot, and points out the close relationship between this genus and *Phyllactinia* in their conidial fructifications and habit. Thus far only the conidial stage has been observed in the pawpaw fungus, but the possibility that it belongs to *Phyllactinia* is not excluded. It has not been observed to spread to the leaves of the mulberry, a known host of *Phyllactinia corylea*, growing near by.

The following is the description given by the author: *Ovulariopsis papayae* n. sp. Sterile hyphae hyaline, epiphytic, penetrating interior of leaf through the stomata and ramifying in the intercellular spaces of the spongy parenchyma; conidiophores arising from the sterile hyphae, erect, cylindrical, pluriseptate, up to 200 μ long, 7 μ diameter; conidia large, borne singly at apex of conidiophores, subclavate, 60 to 90 by 14 to 23 μ, majority 72 by 14 μ; conidiophores and conidia usually smooth, rarely beset with fine projections.

WILTSHIRE (S. P.). **Studies on the Apple canker fungus. I. Leaf scar infection.**—*Annals of Appl. Biol.*, viii, 3–4, pp. 182–192, 1 pl., 1921.

The general view that the apple canker fungus is a 'wound parasite', and that as long as the host remains intact no infection is possible, would appear to be in need of revision, as the author's investigations at Long Ashton, near Bristol, spread over some years, have established the fact that infection in a large number of cases takes place through the scars left by the fallen leaves in the autumn, and also through these scars in the following spring. It is evident that it is only if such natural ruptures of external tissues as those occurring during the normal growth of the tree are regarded as 'wounds' that *Nectria ditissima* (the author expresses no opinion regarding the name *N. galligena* Bres. recently suggested for this fungus) may be termed a wound parasite. It is worthy of note that inoculations of scars from freshly removed leaves, attempted in June 1919, were a complete failure, although wounds treated with the same inoculant produced the typical canker. This is probably due to the more active and vigorous growth displayed by the host in June, as compared with the autumn, when the normal leaf-fall occurs.

In microscopic examinations the dead tissues of the leaf scar were invariably found to be infected by fungi, and amongst these occurred a very interesting, not yet identified, pycnidium-forming

fungus that appeared to be universally present, but whether it contributes in any way to the infection is not known. With the pycnidia, which are either immersed in the leaf scar or may occur outside based on a small mass of hyphae, dark-coloured conidiophores are generally found with spores that resemble *Fumago vagans*, but whether these belong to the pycnidial fungus is uncertain.

The entry of the canker fungus into the tissues is accomplished by means of small cracks in the leaf scar caused by the contraction of the tissue on contact with the atmosphere. These cracks are specially noticeable in the region of the soft tissue adjacent to the leaf traces, and they afford ready access to the fungus before the host is able to form a protective phellogen. Small quantities of water, collecting in slight depressions between the leaf scars and the main stem, no doubt aid the germination of the spores of the fungus. The latter grows very freely in the intercellular spaces of the leaf base, the looser texture of which—as compared with the normal cortex—favours rapid development.

Very similar in its symptoms to the autumn infection is that which occurs in the spring when the enormously increased rate of growth of the buds gives rise to fissures in the leaf scar through which the fungus gains direct and unimpeded access to the deeper tissues of the leaf base, where it develops rapidly, in many instances surrounding the stem and killing the shoot above it. But the infections do not always develop into cankers, the infected tissue being sometimes isolated by the formation of a phellogen, which acts in exactly the same way as when shallow cuts are inoculated artificially. Whilst in some cases the development of the canker may be so rapid as to kill the shoot above it almost immediately, the contrary has been known to occur on other occasions when the canker has taken three or more years to complete the encircling of the stem.

The material used by the author for the study of the canker consisted of seedlings of the cross Kingston Black × Médaille d'Or, two cider varieties, and one of the first points noted was that the shoots became infected during the year following their formation. The ratio of increase from year to year was generally found to be high, counts undertaken in a specific instance giving the following results: On the 1915 wood, one canker; on the 1916, four; on the 1917, twenty-nine; and on the 1918, 434. For 1919 the number was certainly over 600, though exact figures were not obtained. A feature observed in connexion with the disease was the extraordinary large number of infections that occurred in a comparatively restricted area, a single branch of one of the trees, having a diameter of $1\frac{1}{2}$ in. at its base and not more than five years old, showing sixty-five cankers, almost every bud being infected. Trees severely attacked present a partially defoliated appearance.

The loss through canker, especially in the case of young trees, is considerable, and methods of control have therefore received close attention. Winter pruning of bush trees, in which process most of the infected wood is cut out, has given good results, although infection may still occur after the pruning has been done; but with

orchard trees, where pruning is not practised to any extent, a different procedure has to be adopted. Spraying of the leaf scars before the bursting of the buds would appear to be successful in the control of spring infection, and the reduction of the number of cankers obtained in the course of the preliminary experiments at Long Ashton amounted to about 80 per cent.

The spraying of the leaf scars in the autumn, immediately after defoliation, is not devoid of danger as the liquid may spot the fruit still remaining on the trees, and while the employment of a copper fungicide in the case of ripe fruit is obviously objectionable, the alternative of a sulphur spray does not appear to be effective. A further difficulty which presents itself is the rapidity of infection, this very often taking place before defoliation is complete. Provided suitable spraying fluids can be found, at least two sprayings during the autumn would therefore seem to be required to check the disease. Other more promising treatments may yet be discovered, but, meantime, a fact worth noting is that vigorous trees usually hold their leaves longer than weakly ones, and anything that tends to invigorate growth may thus reduce the risk of infection.

BRYCE (G.). **The 'bunchy top' plantain disease.**—*Dept. of Agric. Ceylon Leaflet*, No. 18, 2 pp., 1 pl., 1921.

This disease, which is also known in Fiji, Australia, and Egypt, and has recently been reported from the Bonin Islands, first appeared in the Colombo district of Ceylon in 1913, and has gradually spread to other parts of the island up to an elevation of 3,000 ft. In 1918 a plot of Manila hemp (*Musa textilis*) at the Peradeniya Experiment Station was practically destroyed by it.

The symptoms of bunchy top are easily recognizable. The young suckers of a diseased plantain have their leaves bunched together at the top, growth being arrested at the same time. Diseased suckers never mature or produce fruit, development ceasing when a height of two to five feet is reached. The bunching of the leaves is caused by the stunting of the leaf-stalk which prevents their separation from one another, and causes them to remain closely packed in a rosette, giving the sucker somewhat the appearance of a shaving brush. The leaves are smaller than the normal, lighter in colour (the margins sometimes quite white) and very brittle. As they grow older they become thicker in transverse section and develop a strongly ridged or corrugated surface.

The bulbs of the plants affected by bunchy top show small flecks and lines of a yellow or brown colour. These are scattered throughout the interior of the bulb, and vary considerably both in size and number. The banana root-borer (*Cosmopolites sordidus*) tunnels the bulbs, causing considerable damage, but it is also found in suckers which are free from bunchy top. The roots of affected plants are mostly dead; the larger ones are apparently killed back from the root tip for a considerable distance, but the portions adjoining the bulb remain still living, while the finer roots are generally all dead.

The cause of this disease has not yet been definitely ascertained. Nematodes sometimes occur in the living portions of the roots, but

they are not invariably associated with the disease, so that it is improbable that they produce it. *Rhizoctonia* is prevalent on both the finer and larger roots, but the evidence is insufficient to connect the disease definitely with the presence of this fungus. A preliminary experiment to determine whether bunchy top could be due to a filterable virus gave negative results.

The disease has probably been spread from one district to another by exchange of plantain suckers for planting up purposes. The banana root-boring weevil is very likely also concerned in its local spread.

Bunchy top is much more prevalent in plantain fields which have been allowed to run on for several years from the date of planting up. The bulbs of the old stools in such fields are also riddled by the root-boring weevil. It is therefore advisable to dig up old bulbs and replace them by carefully-selected and healthy suckers at about three-year intervals. The spot from which diseased suckers are removed should be heavily limed, and at least one year should elapse before replanting.

In India, where *Rhizoctonia* frequently occurs on jute, the application of potash has been found to reduce the incidence of disease, besides greatly increasing the yield. This is also the case with bunchy top in the Bonin Islands, where the disease is definitely ascribed to a deficiency of potash in the soil. The addition of a nitrogenous manure to the potash is recommended in both cases. The author advocates a combination of nitrogen, potash, and lime. In small gardens, where an application of expensive fertilisers is impossible, a liberal dressing of wood ash and a mulch of leguminous plants may be substituted.

It has not yet been ascertained whether any Ceylon plantain varieties are immune against bunchy top. In Fiji the *Gros Michel* banana is immune, and the plantain industry, which was practically destroyed by the disease between 1890 and 1900, is again profitable there owing to improved methods of control and better cultivation.

McFarland (F.). **Infection Experiments with Claviceps.**—Abs. in *Phytopath.*, xi, 1, p. 41, 1921.

Successful cross-inoculations are reported of *Claviceps* conidia from *Bromus inermis*, *Agropyron repens*, *Poa pratensis*, and *Arrhenatherum elatius* to rye (*Secale cereale*). Wheat was also infected in certain cases by using conidia from rye, *Arrhenatherum elatius*, *Poa pratensis*, and *Agropyron repens*.

Shear (C. L.) & Dodge (B. O.). **The life-history and identity of 'Patellina fragariae', 'Leptothyrium macrothecium', and 'Peziza oenotherae'.**—*Mycologia*, xiii, 3, pp. 135–170, 3 pl., 5 figs., 1921.

A fungus found growing on strawberries, raspberries, and various other plants was found to have sporodochia, pycnidia, and apothecia in its life cycle. Some twenty-seven names, or combinations, have been applied to these stages. The correct name for the fungus is given as *Pezizella lythri* (Desm.) Shear & Dodge. The conidial (sporodochial) stage is stated to be *Hainesia lythri* (Desm.) v. Höh.,

and the pycnidial stage is *Sclerotiopsis concava* (Desm.) Shear & Dodge.

The conidial stage has been found upon the genera *Acer, Ampelopsis, Castanea, Cercis, Cornus, Duchesnia, Epilobium, Eucalyptus, Fragaria, Gaultheria, Gaura, Hicoria, Jambosa, Lythrum, Nyssa, Oenothera, Vaccinium, Pelargonium, Populus, Potentilla, Prunus, Quercus, Rhus, Ribes, Rosa, Rubus, Salix, Smilax, Ulmus.* and *Vitis.* The pycnidia have been found on most of the above, and the ascus stage on six genera, including *Prunus* and *Rubus.* The above hosts were found attacked in North America, but as the fungus is also known in Europe and South America the list can doubtless be extended.

The fungus is a weak parasite, and was shown by cross inoculations to pass readily from one host to another. The ascigerous stage appears to have been described but once, as *Peziza (Mollisia) oenotherae* Cke & Ellis. The pycnidial stage has received at least four generic names, *Ceuthospora, Leptothyrium, Sporonema,* and *Sclerotiopsis,* and twelve specific, one of the best known being *Leptothyrium macrothecium* Fckl. The conidial stage has been referred to the genera *Dacryomyces, Sphaeronema, Gloeosporium* ?, *Tubercularia, Hainesia, Hymenula,* and *Patellina,* the most recent of the ten specific names traced being *Patellina fragariae* Stev. & Pet.

The chaos which at present prevails in the taxonomy and morphology of the Ascomycetes is considered by the authors to be in imperative need of serious attention from mycologists and pathologists. The most practicable and effective plan for establishing generic names is believed to be the fixing of a type species for each genus which shall furnish a basis for a definite application and interpretation of the genus. The importance of life-history studies is also emphasized.

PAILLOT (A.). **Les traitements simultanés contre les Maladies cryptogamiques et les Insectes parasites des Arbres Fruitiers par les Bouillies mixtes.** [Simultaneous treatment with mixtures for Cryptogamic diseases and parasitic Insects of Fruit-trees.]—*Ann. des Épiphyties,* vii, pp. 169–194, 1921.

Considerable progress has been made in the United States and Nova Scotia of recent years in the simultaneous treatment, by mixed preparations, of insect and fungus diseases. Experiments were undertaken during 1919 and 1920 by the French South Eastern Entomological Station in the Drôme and Rhone Departments with the following objects: (1) The comparative study of the efficacy of different formulas of mixed compounds adapted to practical use. (2) The selection of those most suitable for recommendation on account of their low retail price or easy preparation. (3) The determination of the most favourable periods for the application of the different treatments. (4) The formulation of general principles of application.

The experiments comprised cupro-arsenical and lime-sulphur-arsenical mixtures, and were carried out on apple and pear trees. In cupro-arsenical mixtures the copper salts may be the sulphate or acetate (verdet), while the arsenic may be given as lead arsenate

or lime arsenate. In the experiments described the following combinations were used:—(1) Neutral verdet (of 32 per cent. copper) 0·750 kg., commercial lead arsenate ('Bouillie Billault à poudre unique') 1 kg., and water 100 litres. This is very easy to prepare, and applied to William pears doubled the yield, and reduced scabbed fruit from 75 per cent. to 5·1 per cent. in one case. It is, however, liable to cause damage by scorching the young leaves and fruit unless applied at the right moment. (2) Lead arsenate-Bordeaux mixture (Bouillie Billault 1 kg., Bordeaux mixture (of 1 per cent. copper sulphate) 100 litres). This caused severe scorching in the one experiment made. (3) Lime arsenate-Bordeaux mixture (copper sulphate 1 kg., freshly slaked lime 3 kg., dry lime arsenate 300 gm., water 100 litres). This is more troublesome to prepare. The commercial lime arsenate used was in two forms, as powder and paste, which appeared to be of equal value, but the paste requires to be used in double the dose given in the above formula (600 instead of 300 gm.). This mixture should not be applied during the flowering period, but should be replaced at that period either by a simple lead arsenate spraying (without copper) or by the following: liver of sulphur, 300 gm., dry lime arsenate 300 gm., freshly slaked lime 3 kg., water 100 litres. In some cases the yield was more than doubled, and the percentage of scab on the fruits reduced from 90 to 4 with this mixture.

In general the results obtained with these different types of cupro-arsenical mixtures were almost equally satisfactory. *Fusicladium* scab on the fruit rarely exceeded 5 per cent. in the treated trees, whereas the untreated had often over 50 per cent., while the control of the fruit worms (chiefly *Carpocapsa*) was almost equally good.

Arsenical lime sulphur mixtures, widely employed in the U.S.A., Canada, and Italy, are as yet little known in France. They are made up with polysulphides of calcium which vary considerably according to the quality of the lime, the respective weight of the ingredients, the physical conditions of preparation, and the chemical composition and constitution. The commercial concentrated liquids, of which there are several satisfactory types, are chiefly used. Dry lime sulphur, which is much employed in America, has all the properties of the liquid mixtures and is more easily transportable. The arsenical lime sulphur mixtures used were as follows: (1) Lead arsenate-lime sulphur (concentrated commercial liquid lime sulphur (32° Baumé) 4 litres, lead arsenate (Swift) 600 gm., water 100 litres). This gave good control of scab and caterpillars on pears, the improvement with apples being less marked. (2) Lime arsenate-lime sulphur (concentrated lime sulphur as above 4 litres, lime arsenate paste 600 gm., water 100 litres). This caused burning, probably owing to inferior lime sulphur. It gave a good control of scab and *Carpocapsa* on pear and mildew of apple. The lime arsenate paste can be replaced by half the quantity of dry lime arsenate and the liquid lime sulphur by dry lime sulphur (500 gm.) without apparent difference.

All sprayers are not equally suitable for use with lime sulphur mixtures, brass or leaded steel being superior to copper. Most of the American apparatus for work on a large scale is made of bronze.

From the point of view of efficacy against diseases and pests of apple and pear there is little to choose between the copper and lime sulphur mixtures. The latter are, however, less expensive. Unfortunately it will not be easy to secure their extended use in France, where copper sprays are traditional.

In the writer's opinion three treatments with any of the above-mentioned preparations are sufficient to protect the trees against their chief parasites in the spring. The first should take place when the buds are bursting into flowers. If *Cheimatobia* are not numerous the first spraying may be without arsenate and may be advanced so as to coincide with the treatment of peach trees for leaf curl, or may even be, in the case of apple trees, omitted altogether.

The second treatment should be given at the end of the flowering period, when the petals begin to fall. The practice of spraying in the middle of the flowering season is not to be recommended.

The third treatment should take place ten to fifteen days after the foregoing, when the fruits are well formed.

The following measures are absolutely necessary to ensure successful treatment:—The first spraying being directed principally against the *Fusicladium* scab and the young larvae of *Cheimatobia* and *Hybernia*, all parts of the tree, including the wood, should be well covered. The second application aims chiefly at the extermination of *Carpocapsa*, the entire larval existence of which is passed in the interior of the fruit, so that it is vulnerable only at the moment of penetration. In the majority of cases this penetration takes place through the calyx, and the aim should therefore be adequately to protect the fruit by filling the depression of the calyx with insecticide. This is not easily effected with the ordinary apparatus, unless the nozzle is placed as near as possible to the flowering clusters. It is necessary to insist on these details since their non-fulfilment may annul the efficacy of the treatment. The same conditions apply to the third application.

The American spray pumps, which discharge the spray at a high pressure, are best suited for the treatment of orchards on a large scale and are more useful than the ordinary knapsack sprayers used in France. Owing to the high pressure, the drops are forcibly ejected, rapidly and effectively covering all parts of the tree. The writer considers that the problem of treating fruit-trees is more mechanical than chemical. Good mixtures are not scarce, but the machines available in France require to be improved.

FEYTAUD (J.). **Essais de Bouillies mixtes pour le traitement des Arbres Fruitiers.** [Experiments in the treatment of Fruit-trees by combined mixtures.]—*Ann. des Épiphyties*, vii, pp. 195–236, 1921.

Experiments were carried out in 1918 and 1919, near Bordeaux and in the province of Dordogne, on apple and pear trees, with the following mixed formulas:—Lime arsenate or lead arsenate combined with Bordeaux mixture or lime sulphur or di-basic copper acetate (verdet gris). The treatment was directed both against insects and fungi, especially *Carpocapsa pomonella* L., *Venturia pirina*, and *V. inaequalis*. As in the experiments reported by

Paillot [see last abstract] lead arsenate with lime sulphur caused little damage to apple foliage, but when lime arsenate or copper acetate was used the leaves were sometimes scorched. Bordeaux mixture caused no damage in the combinations tried on apples, but on pears some scorching was produced when it was mixed with lime arsenate.

In general there appears to be no great advantage in replacing lead arsenate by lime arsenate. The combined mixtures (Bordeaux or lime sulphur mixture with lead arsenate) are to be recommended in place of simple lead arsenate, as simultaneous treatments against *Carpocapsa* and *Venturia*. The Canadian formula of Bordeaux mixture (five times as much slaked lime as sulphate of copper, the latter not to exceed 1 per cent.) is to be recommended. The addition of resin soap was not found to be advantageous.

On the whole the combination of lead arsenate with basic Bordeaux mixture was more effective than with lime sulphur, though the latter produced very good results. The advantages of the Bordeaux combination are due largely to the excess of lime, which gives greater adhesiveness, increased insecticidal efficiency, and is effective in killing the eggs of *Carpocapsa*.

The addition of arsenical salts increased the efficacy of the fungicides against *Venturia*. Even the simple lead arsenate mixture (Bouillie Billault) gave marked results in controlling this disease. The best time for the application of the first spraying to apple trees is during the ten days following the end of the flowering period; pear trees that are liable to scab should be sprayed also within ten days of the fall of the petals, but the main treatment should come later, about the same time as the first spraying of apple (first half of May near Bordeaux). Supplementary sprayings are often advantageous or even necessary in severe attacks, and may have to be given both before and after those mentioned.

THIELE (R.). **Kolloidaler (flüssiger) Schwefel zur Bekämpfung des Mehltaues.** [Colloidal (liquid) sulphur for the control of Mildew.]—*Deutsche Obstbauzeit.*, lxvii, p. 113, 1921.

Hitherto the powdery mildews of vines, hops, fruit-trees, and other economic plants have been treated mainly with sulphur in the form of a powder, but the scattering of minute particles by the wind is a great drawback to this method. Hollrung ('Mittel zur Bekämpfung der Pflanzenkrankheiten', p. 8) recommends, as a general principle, the use of liquid sprays in preference to powders wherever possible.

A proposal, based on practical experience, has now been made to use sulphur in the form of a colloidal watery paste. This method has many advantages. Colloidal sulphur is far more effective than the most finely-ground sulphur powder. The mixture adheres firmly to the plant, and is not blown away by the wind like the powder. The sulphur is better distributed by spraying than by dusting. The dissemination of the colloid expedites the oxidation of the sulphur in the air. It can be applied in any weather, and the same apparatus can be used for spraying with Bordeaux mixture and with colloidal sulphur, so that these two treatments can be applied simultaneously. The economic advantages are

considerable. If this method were generally adopted, the quantity of sulphur imported into Germany for agricultural purposes should be reduced to one-tenth of the present figure.

SMITH (J. H.). **The killing of Botrytis spores by Phenol.**—*Annals of Appl. Biol.*, viii, pp. 27–50, 1921.

The writer, using *Botrytis cinerea* spores from a single-spore isolation grown on Czapek's medium, tested the effect of phenol in killing the spores under various conditions. All the spores do not die simultaneously. In 0·4 per cent. phenol at 25° C. some 7 per cent. are killed in 50 minutes, and 3 per cent. are still alive after 160 minutes. With 0·6 per cent. phenol, only 0·39 per cent. are alive after 30 minutes. When the temperature is lowered, more time is necessary to kill the spores. The use of larger numbers of spores also causes a slowing in the rate of killing in a given phenol solution. Younger spores are more susceptible to phenol than are older spores.

The curves, plotted to indicate the number of survivors after successive intervals of time, are discussed in some detail. They are usually of the sigmoid type with a stage of increasing steepness, a maximum, and finally a stage of decreasing steepness, flattening out more and more as time goes on. This result is at variance with the curve generally accepted as the typical mortality curve for bacteria exposed to disinfectant agents, which is usually regarded as a logarithmic one; but the sigmoid curve has been obtained in many other biological investigations of the kind. With an increase in the strength of phenol used, the curve obtained approaches more nearly to the logarithmic type. Both curves are considered to be explicable on the assumption that the individual spores differ in their resistance to phenol and that if the number showing each grade of resistance be plotted, the resulting curve approaches a normal frequency curve.

MORSTATT (H.). **Zur Ausbildung für den Pflanzenschutzdienst.** [Training for the Plant Protection Service.]—*Zeitschr. für Pflanzenkr.*, xxxi, 3–4, pp. 89–94, 1921.

The author considers that plant pathology should be regarded as a specialized and independent branch of applied biology, and that the present controversy whether plant protection should enter within the scope of applied botany or of applied zoology, alone, is fruitless, since both these sciences are but subsidiary branches in the training of men for the plant protection service.

The word 'phytopathology' has lost much of its original meaning (pathological anatomy and physiology of plants); in Germany, for instance, it is understood as the study of plant diseases in the widest sense, while in America it covers chiefly the study of plant diseases caused by vegetable organisms, especially fungi and bacteria.

Plant pathology has undergone three marked phases of development in recent times. It started with the investigation of plant pests—fungi, bacteria, and insects; the next step consisted in endeavours to check such pests, chiefly by means of chemical pre-

parations; and lastly arose the question of plant hygiene in contrast with purely therapeutical methods. From this followed a number of new points of view and tendencies, such as, for instance, the study of the influence of weather, soil, and other environmental factors on the spread of epidemics; transportation and importation of pathogenic agents and of their carriers; the question of susceptibility and resistance of varieties, which led in practice to the cultivation of immune varieties; the problem of virulence in pathogenic organisms; lastly, the so-called biological control of disease. Such preventive measures as improved cultivation, pruning, manuring, rotation of crops, as well as quarantine and the disinfection of seeds, are to be regarded as falling within the scope of pure hygiene.

These considerations lead to the conclusion that a 'phytopathologist' must be also a hygienist, that is, he must be fully conversant with all sides of the question (including cultivation methods) in order to be able, when investigating diseases and pests, to grasp the combined action of the various causative factors and to judge their individual bearing on the disease. His specialization in the aetiology of diseases due to fungi, bacteria, insects, &c., or in questions appertaining to cultivation, use of chemicals, and the like, should come only in the second place. It is a fact well known to all persons dealing in practice with plant protection problems that one-sided control measures against plant pests are not sufficient, and that it is necessary to investigate the whole ecology of the cultivated plant in order to find the most appropriate point from which the disease can be controlled. It must be remembered, too, that there are non-parasitic diseases, as well as diseases for which the pathogenic agent is still unknown, or in which the part played by the latter is but small in comparison with other circumstances which prepare the ground for it; and this is true not only of fungi and bacteria, but also of a whole series of insects.

There is a close parallel between the practical plant pathologist and the general practitioner in medicine. The former must be in a position to diagnose on the spot the symptoms of a disease or attack of a pest and to give prompt advice. This does not exclude in the least, any more than in human medicine, the necessity for having trained specialists for dealing with particular cases. In this respect the author points out a defect in the available literature intended to give practical help to cultivators, namely its division into zoological and botanical publications; and he asks what use to a horticulturalist is a book dealing, for instance, with the cabbage root weevil and not with clubroot. There is a great difference between writing a handbook for the pathologist and compiling practical advice for farmers; in the former case specialization is quite correct, but in the latter it is hardly admissible.

The fact should therefore be recognized that it is not sufficient to be a specialist *(mycologist, entomologist, or other) in order to be fit* for the plant protection service. The training for this service, if it is to give the practical results which are aimed at, must be of a general nature, so that the subject may be viewed in all its bearings from a central standpoint and not from the outside point of view of the botanist or zoologist or other specialist.

BOYLE (C.). **Infection by Sclerotinia libertiana.**—*Ann. of Botany*, xxxv, pp. 337–347, 1 pl., 1921.

The conclusions arrived at by the author may be summarized as follows:

Investigations into the early stages of infection of bean leaves (*Phaseolus coccineus* and *Vicia faba*) have shown that the hyphae of the ordinary mycelium and also the appressoria growing in turnip-juice are surrounded by a mucilaginous sheath, which can be easily demonstrated by mounting a piece of actively growing mycelium in Indian ink or by a short staining in dilute aqueous gentian-violet and mounting in water. This sheath cannot always be demonstrated in the case of aerial hyphae. When a hyphal tip is brought into contact with any resistant material, e.g. a cover-slip or the surface of the host, there is a modification in the staining reaction of the wall of the tip. This modification extends a short distance behind the point of contact, and in the case of appressoria it is very pronounced. An 'infection hypha' arises from the tip of each hypha in contact with the host plant or a glass surface, and in the former case this penetrates the host under suitable conditions. The point of origin of this infection hypha is early visible as a thinning of the hyphal wall, simulating a germ-pore. The infection hypha is very narrow, and has a normal unmodified wall. At the point of contact with this hypha the cuticle may be much indented as a result of pressure.

The invading hyphae appear to be fixed to the cuticle by means of the mucilaginous sheath. At this stage there is no evidence of the softening or solution of the cuticle or sub-cuticular layers of the host, and the rupture of the cuticle by the infection hypha seems to be due to mechanical action only. As soon as this process has taken place, the subcuticular tissue is rapidly disorganized, but even at a late stage the cuticle undergoes no chemical change. Under similar conditions the penetration of the host may occur with or without the formation of appressoria. Thus the method of hyphal 'mass infection' adopted by *Sclerotinia libertiana* is physiologically similar to infection by *Botrytis cinerea* and *Colletotrichum lindemuthianum* as described in the earlier 'Studies'.

DUFRÉNOY (J.). **La transmission des maladies des plantes par voie biologique.** [The transmission of plant diseases through biological channels.]—*Rev. gén. des Sciences*, xxxii, 13, p. 389, 1921.

There are few more important problems in phytopathology than that of the transmission of disease by animals. Recent researches have facilitated the classification of the means of transmission, which may be enumerated as follows: (1) Insects, by wounding the host, prepare the way for parasites which are incapable of penetrating the sound epidermis. (2) Insects transport the parasite on their teguments and deposit it on lesions, or on the natural channels of penetration. (3) The pathogenic germs, ingested by animals, are deposited on the host after passing through the alimentary canal; thus birds are responsible for the rapid dissemination of *Microsphaera mors-uvae* on gooseberries in France and of *Endothia parasitica* in the chestnut-forests of America, while

squirrels have been proved to communicate *Peridermium* to the pines which they gnaw; in the soil nematodes, mites, and cockchafer larvae disseminate spores and bacteria. (4) Parasitic forms, accumulating in the alimentary canal, multiply, and remain there during a part of their life-cycle. Thus the Coleoptera, *Diabrotica vittata* and *D. duodecimpunctata*, harbour in their alimentary canal during the winter *Bact. tracheiphilus*; these 'germ-carriers' inoculate with wilt the Cucurbitaceae which they attack in the spring. Still more intimate is the connexion between *Bact. Savastanoi* and the olive-fly (Petri, 1909).

The transmission by insects of infectious mottling diseases (chlorosis, mosaic, leaf-curl) of potatoes, and probably of wild plants such as peppermint, renders the preservation of uninfected varieties extremely difficult. The wild plants or the insects themselves act as a receptable for the virus, and ensure its hibernation.

Sometimes insects become the prey of the fungi which they have transported: thus, *Beauveria* soil-saprophytes become entomophytes, following Bostrichid beetles into their galleries, while Laboulbeniales of the genus *Rickia* appear to be disseminated on Coleoptera and ants by symbiotic or parasitic Acarians.

Sometimes also the carrying insect lives in association with the transported parasite; Mangin and Viala have shown how a cochineal (*Dactylopius vitis*) associates on the roots of the vine with a fungus (*Bornetina vitis*), in order to be able to survive in very dry countries, such as Palestine. Very often, however, the insect carries fungi and bacteria merely accidentally, but with disastrous effects on cultivation.

Marchal has succeeded in curing epidemics of *Exobasidium azaleae* on greenhouse azaleas by the suppression, with tobacco fumigations, of the white fly (*Aleurodes vaporarius*), which transported the spores to the buds. This example should prove useful in stimulating efforts to destroy germ-carriers, which the author considers to be one of the principal methods of combating plant-diseases.

HOTTES (C. F.). **A Constant Humidity Case.**—Abs. in *Phytopath.*, xi, 1, p. 51, 1921.

The apparatus to maintain a constant humidity within a variation ± 1 per cent. consists of a plant chamber $20 \times 20 \times 20$ in. constructed of wood with the top and sides of three thicknesses of glass to give two dead air spaces for insulation. The case is furnished with the Johnson Service Co. humidostat and thermostat. The case sits on an accurately fitted base three inches in height, through which the supply pipes for the moist and dry air, respectively, pass into the case. The heating elements for the maintenance of a uniform temperature are attached to this base. Between this shallow base and another, ten inches in height, is a perforated 'transite' plate through which the shoots are passed into the plant chamber. The roots, in soil or nutrient solution, may be placed under conditions like or unlike those of the shoot, through independent regulation of the temperature, &c., of this lower base. The humidity is controlled by the humidostat making contact, now with one, then with the other terminal of an electro-magnetic valve (Johnson Service Co., old style) that will shift the flow of compressed air (20 lb.)

through the humidifying or the drying apparatus respectively. The humidifier consists of a ten-litre aspirator bottle furnished with an inlet tube tipped with De Vilbiss atomizer No. 28, and partly immersed in distilled water. The air from the valve, passing through the atomizer, forms a fine spray, and thus becomes rapidly charged with moisture, especially if the water is slightly heated. The air leaves the aspirator bottle through a condenser head, and is delivered to the plant chamber by a connecting tube. The drying apparatus consists of a series of calcium chloride towers or a sulphuric acid atomizer (glass) for drying. The regulation is very simple, and the range of the instrument is from 20 to 95 per cent. relative humidity. When adjusted for medium humidity and without plants in the chamber, the change from moist to dry air and the reverse occurs at intervals of about three minutes. With plants in the chamber the interval on the dry air is lengthened.

PANTANELLI (E.). **Sui rapporti fra nutrizione e recettività per la ruggine.** [The relation between nutrition and susceptibility to rust.]—*Riv. di Patol. Veg.*, xi, 3–4, pp. 36–64, 1921.

After a summary of the work of previous investigators on the relation between nutrition and the attack of rust fungi, the author describes three years' experiments (pot and water-cultures) directed to ascertain the factors favouring susceptibility to rust in wheat, oats, maize, and beans inoculated with *Puccinia glumarum tritici*, *P. coronata*, *P. sorghi*, and *Uromyces fabae* respectively. In the main experiments ten series of cultures were undertaken, the nutrient solutions being given as follows:—(1) Tap-water. (2) Sodium nitrate. 3. Ammonium carbonate. 4. Potassium bicarbonate. 5. Potassium nitrate. 6. Monopotassium phosphate. 7. Magnesium sulphate. 8. Sodium sulphate. 9. Sodium nitrate with monopotassium phosphate. 10. Sodium nitrate with monopotassium phosphate and magnesium sulphate. There were also several subsidiary series of water-cultures.

In the first series, lack of nutrition reduced susceptibility in the cereals, ultimately rendering them immune. With beans, on the other hand, it allowed a severe attack in the water-cultures, though not in the pots with sand. In the series with sulphate of magnesium and of sodium respectively, although in these the primary nutrient elements were absent, severe infection also occurred.

Sodium nitrate augmented susceptibility strongly in the cereals; in maize the cultures with only this salt were always the worst attacked. This cannot be attributed merely to the excess of nitrogen, as the series with ammonium carbonate in equivalent doses of nitrogen remained practically immune. Beans maintained immunity both with sodium nitrate and ammonium carbonate given alone. A subsidiary experiment showed that when ammonium salts were added to sodium nitrate the attack was severe, this being true even with beans. The addition of nitric acid to other nutrient salts from which nitrogen was eliminated increased susceptibility in the cereals, but not with beans. The observations suggested that a rapid absorption of nitrogen increased susceptibility.

Potassium bicarbonate increased resistance in the cereals but

diminished it in the beans. Potassium nitrate increased susceptibility in cereals and beans.

Phosphoric acid given alone slightly increased susceptibility. Combined with potassium the action was contradictory, oats and beans remaining immune, while wheat was lightly attacked and maize was attacked in the same degree as the control. Added to sodium nitrate, the phosphate did not limit the favourable action of the former to rusts, and with ammonium there was a great increase in susceptibility, even in the case of beans.

Magnesium sulphate given alone increased susceptibility, but the effect was not cumulative when nitrate was added in series 10. The high concentration of the substratum, however, must be taken into account in the latter case.

Sodium sulphate also slightly augmented susceptibility, which suggests that the high degree of susceptibility observed in the sodium nitrate series was partly due to the action of the sodium.

Judging by these results, it appears probable that a plentiful supply of nitrogen increases susceptibility, that potassium exerts contradictory effects, that phosphoric acid is slightly favourable to rust, and that poor nutrition increases resistance. In the water-cultures tests were made which showed that the absolute elimination of particular elements such as nitrogen, phosphorus, potassium, or magnesium, while supplying in each case a normal quantity of the others, increased resistance. But the elimination of chlorine and sulphur from an otherwise complete nutrient solution results in a degree of susceptibility similar to that induced by a good nitrogen-phosphatic nutrition.

A fact regularly observed was that the rusts preferred the plants with the most rapid growth. Rapidity of growth must, however, be distinguished from increase in dry weight, for while nitrate of soda induces rapid growth, it gives ultimately, in cultures such as these, a less prosperous development than ammonium carbonate in the young plants. In the former case the attack was severe, in the latter the plants remained almost immune.

The root-system did not develop in proportion to the aerial parts; the more luxuriant the growth of the stems, the less was (comparatively) the weight of the roots. Whereas in maize and wheat no correlation was apparent between susceptibility and the ratio of the roots to the stems, in oats and beans the connexion was evident. In the case of the two latter crops, the greater the development of the roots in respect to that of the stem the more severe was the infection. The observations suggested that this depends more on the activity of the absorption than on the size of the absorptive system. It was also observed that infection was very severe in cases where much water was absorbed by the plant in proportion to the weight of its absorptive system during the period immediately preceding inoculation. This indicates that a diminution of the absorptive activity of the roots tends to lessen the susceptibility of the leaves, quite independently of their respective development. The behaviour of the series with double or triple formulas, in which the concentration of the nutrient solution was higher than when the salts were given alone, supports this view. In these series the higher concentration induced a relatively lesser

absorption of water, and the susceptibility was not so great as might be expected when sodium nitrate and magnesium sulphate were combined.

The effect of the varying degrees of acidity and alkalinity in the nutrient solutions was examined. The relative absorption of water in regard to the extent of the absorptive system was promoted by a neutral or slightly acid reaction, and decreased by an alkaline or strongly acid one. Susceptibility to rust did not fluctuate in the same way, though a marked acidity of the nutrient solution, sufficient to impede the absorption of water, always promoted immunity. Slight acidity increased immunity when the acids were of such a nature as to favour synthetic processes in the plant (phosphoric and sulphuric acids), but induced susceptibility when the acids interfered with the synthesis of the albumins and more complex carbohydrates (nitric and hydrochloric acids).

Alkalinity of the nutrient solution, if not too marked, increased susceptibility because the synthetic processes were impeded (sodium nitrate, sodium sulphate, potassium and sodium carbonates), but when sufficiently pronounced to produce injurious effects on the plant, immunity was induced (higher concentration of sodium and potassium carbonates, ammonium carbonate).

While an indirect relation must be recognized between susceptibility to rust and reaction of the nutrient solution, the results are not entirely due to the effects of this reaction on the activity of the roots. Modifications in the internal metabolism, as discussed below, are evidently involved.

Analyses were made at the moment of inoculation of some of the plants in each series. No correlation was established between the water-content of the leaves and susceptibility. So also it was not possible to find any relation between the density of the aqueous extract of the leaves and susceptibility. The molecular concentration of the extract, determined by the cryoscopic method, appeared to have no regular bearing on the rust attack. But by comparing the mineral components (ash) with the density and the molecular concentration of the extract an important relation was found, namely, that the richer the sap in organic substances and mineral salts, the greater was the susceptibility to rust. The reaction of the nutrient solution surrounding the roots affects this relation; weak external acidity promotes the absorption of water as compared with salts, while alkalinity or high acidity decreases the absorption of water and allows of the relatively greater penetration of salts. In the former case, the cellular sap being deficient in salts, the plant shows less susceptibility.

The work of Comes has revived the discussion as to the rôle of acids and sugar in the determination of resistance and susceptibility respectively. In the foregoing experiments it was found that in the cultures with potassium phosphate the sap contained slightly more free acids. No definite relation was established in regard to free acids in the other cultures, although their degree of susceptibility varied. It is pointed out, however, that the greater part of the vegetable acids of the sap are present in a combined form, and when these were determined it was found that the more susceptible plants (e.g. those grown in solutions of sodium or potassium nitrate)

were the most deficient in free and combined acids, so that, in a very general sense, a connexion may be established between the total acid-content and resistance. Two points, however, must be borne in mind: 1. That the 'stronger' organic acids, such as oxalic and tartaric, may disguise an eventual relation due to 'weaker' acids, such as malic, or those of a higher molecular weight, such as citric. 2. That if the sap is rich in organic nitrogenous bases combined with acids, there is a loss during heating, not only of the base but also of the acid and the derived carbonic acid. For this reason the combined acidity, simply calculated by the alkalinity of the ash, may appear less than it actually is.

Sugar was more plentiful in the susceptible plants (sodium and potassium nitrate, magnesium sulphate, &c.), decidedly scarce in the resistant cultures (controls, potassium carbonate), except that it was abundant in the ammonium carbonate series, which was the most resistant. Resistance was greater in plants in which the synthesis of the more complex carbohydrates was best effected.

No relation was found between susceptibility and the percentage of total nitrogen and soluble nitrogen in proportion to the dry substance, whereas it was noted that susceptibility increased with the preponderance of soluble over insoluble nitrogen. The same connexion was observed in the case of phosphorus. These facts show that susceptibility is greater when the synthesis of albumins and other phosphoric compounds insoluble in water is impeded.

Thus the most salient characteristics of the constitution of the sap of leaves susceptible to rust are a preponderance of sugar over the more complex carbohydrates, and of soluble nitrogenous and phosphoric substances over insoluble.

In further experiments it was found that the sulphates of iron, zinc, and aluminium, and chloride of barium conferred immunity or reduced susceptibility. On the other hand, manganese sulphate and copper sulphate did not prevent a severe attack of rust, while the former actually increased susceptibility. In this last case, development was very luxuriant, but the same was also true with iron. Both iron and manganese were found to be absorbed by the plant. Sulphate of copper stimulated growth, but zinc, aluminium, and barium retarded it.

It will be evident from the foregoing investigations that malnutrition does not predispose the plant to attack by rust, the contrary being rather the case. The augmentation of resistance observed in practice to result from an excess of phosphate relatively to nitrogen is due merely to the retardation of growth. When the phosphate nutrition is balanced in regard to nitrogen there is no such influence. An increased concentration of the nutrient solution diminishes susceptibility in so far as it reduces the absorptive activity of the roots, but not by increasing the osmotic pressure of the sap in the leaves, since no relation between the latter and susceptibility appeared to be present. Of more importance is the concentration of organic substances in the sap. Resistance is apparently increased by the augmentation of free acids of low molecules, while the more susceptible organs are richer in sugar, in acids of large molecules, and in soluble compounds of phosphorus and nitrogen.

DOOLITTLE (S. P.). **The relation of wild host plants to the over-wintering of Cucurbit Mosaic.**—Abs. in *Phytopath.*, xi, 1, p. 47, 1921.

Mosaic was transmitted from cucumber to *Asclepias syrica*, *Capsicum annuum*, and *Martynia louisiania*, and from these plants to cucumber. The wild cucumber (*Micrampelis lobata*) is, however, most important in the over-wintering of cucumber mosaic. The disease is transmitted through the seed of the wild cucumber. Eradication of this plant and the milkweed may be of value in controlling mosaic.

DOOLITTLE (S. P.). **Influence of temperature on the development of Mosaic diseases.**—Abs. in *Phytopath.*, xi, 1, p. 46, 1921.

Higher soil and air temperatures were found to favour the development of cucumber mosaic. Inoculations at a soil temperature of 18° C., when the air temperature was about 20° C., gave a few cases, but none when the air temperature was below 20° C. Between 22° and 27° C. soil temperature the percentage of infection did not vary, but the incubation period was longer at an air temperature of 18° than at 30° C. With soil temperatures from 27° to 30° C., regardless of air temperature (from 18° to 30° C.), incubation was shortened and the percentage of infection increased. Field observations on aster yellows strengthen these conclusions.

CRAWFORD (R. F.). **Over-wintering of Mosaic on species of Physalis.**—Abs. in *Phytopath.*, xi, 1, p. 47, 1921.

Tomato mosaic was transferred to *Solanum dulcamara*, *S. nigrum*, *Physalis longifolia*, *Nicandra physaloides*, and *Datura stramonium*. *Physalis longifolia* is a perennial weed which may carry the mosaic of cultivated Solanaceae over winter.

MELIN (E.). **Über die Mykorrhizenpilze von Pinus silvestris L. und Picea abies (L.) Karst. (Vorläufige Mitteilung).** [The Mycorrhiza Fungi of *Pinus silvestris* L. and *Picea abies* (L.) Karst. (Preliminary Note).]—*Svensk Botan. Tidskr.*, xv, 2–4, pp. 192–203, 9 figs., 1921.

For some years the author has been occupied with the study of the ectotropic mycorrhiza of Swedish forest trees, the first results of his investigations having been published in *Akad. Avh.* (Uppsala) in 1917. After having satisfied himself of the vital importance in certain types of soil of mycorrhiza formation, his next object was to isolate the fungi concerned. So far three distinct, genuine mycorrhizal fungi have been isolated from the pine, and one from the fir. The occurrence of clamp-connexions on the hyphae in all cases refers these fungi to the Hymenomycetes. No fructifications were formed, but in certain conditions the hyphae develop terminal or intercalary swellings, as is also the case with the fungi of the *Calluna* mycorrhiza. Growth in pure cultures is usually very slow. For the present, the fungi isolated in these experiments are termed *Mycelium radicis silvestris* (from *Pinus sylvestris*) and *M. r. abietis* (from *Picea abies*).

Mycelium radicis silvestris. The three forms isolated (α, β, γ) exhibit such striking morphological and physiological differences

that they must probably be regarded as distinct species. It is uncertain, even, whether they all belong to the same genus. *M. r. silvestris* (α) was isolated from mycorrhiza of the nodule type. On nutrient gelatine the aerial mycelium is usually thick, resembling cotton-wool, white, or with a faint tinge of yellow or pink. The hyphae frequently branch at the same height on either side, giving a characteristic appearance recalling a branched candlestick. The aerial hyphae are very thickly covered with elongated nodules of an excreted substance, which give them a papillose appearance. Clamp-connexions only occur occasionally in very old cultures. A brownish colouring matter is usually excreted. *M. r. silvestris* (β) was isolated from mycorrhiza of the forked type. On nutrient gelatine the aerial mycelium is usually white and fleecy, and consists of very slender hyphae (about 2 to 2·5 μ in diameter). Clamp-connexions are very frequent. Mycelial strands composed of intertwined hyphae are absent. A yellowish-brown colouring matter is excreted. *M. r. silvestris* (γ) was isolated from mycorrhiza of the same type as the last. Growth takes place chiefly on and under the surface of the substratum, only a sparse light-grey to grey-brown aerial mycelium being formed. In many cases even this is absent. A dark brown or olive-green colouring matter is generally formed, sometimes in such a way that the dark-brown colonies are surrounded by an olive-green areola. On the whole, the hyphae are thicker than in the last (about 3 to 3·5 μ). The clamp-connexions are well developed. Mycelial strands composed of 2 to 10 intertwined hyphae are frequent.

M. r. abietis. So far only one mycorrhizal fungus of *Picea abies* has been isolated. Growth is mainly on and under the surface of the substratum, with rather sparse, greyish, aerial hyphae, which are sometimes altogether absent. The colouring matter and hyphae resemble those of *M. r. silvestris* (γ), and possibly these two forms belong to the same species.

Another fungus has been almost constantly isolated by the author from older mycorrhiza, as also from the young tap-roots of pines and firs. This fungus does not belong to the genuine mycorrhizal fungi, being morphologically and physiologically distinct from them. It has been provisionally named *Mycelium radicis atrovirens*, and may be described as follows: Compact, generally greyish mycelium composed of slender hyphae without clamp-connexions. Strands of 2 to 10 intertwined hyphae frequent. Growth much more rapid than that of the genuine mycorrhizal fungi. A dark olive-green colouring matter is formed. Conidia were not developed.

Inoculations were carried out on sterile seedling plants with the above-mentioned fungi, non-inoculated plants being grown simultaneously in pure cultures. The results were as follows:—(1) *M. r. silvestris* (α, β, and γ) and *M. r. abietis*, which develop very slowly on plates in pure culture, exhibit a more active rate of growth in association with the seedlings, and all form ectotropic mycorrhiza. Infection takes place more rapidly in sand than in humus cultures, probably because the hyphae are better developed in the former. At first the hyphae grow intracellularly in the outer cortical cells, where they form pseudoparenchymatous aggregations. The

'Hartig's braidwork' and hyphal coating are not developed till later. External infection occurs through the root-hairs, or, in their absence, through the epidermal cells. The roots of uninoculated plants resemble those of non-mycotropic plants; there is no marked difference between short and long roots, and the root-hairs are well developed. The seeds of *Pinus silvestris* and *Picea abies* can germinate without the co-operation of the fungi. They also develop very well in pure culture, given a supply of nitrogen in an assimilable form. *M. r. atrovirens* forms no ectotropic mycorrhiza. The plants are attacked parasitically, the fungus penetrating the lateral roots and living exclusively within the cells. Root-hairs are not formed. Starting from the lateral roots, the fungus permeates the entire root-system and also penetrates the aerial portions of the stem as far as the needles. The inoculated plants die after a few months. The shortened lateral roots strikingly resemble the pseudomycorrhiza described by the author in 1917, and there is no doubt that this fungus also produces pseudomycorrhiza in nature.

Several writers have expressed the opinion that the mycorrhiza fungi are disseminated by means of the seed, but the author's investigations do not confirm this view. The seeds of old cones are frequently infected by various other fungi, which flourish on the surface of the testa after penetrating the dead scale-cells. The endosperm, like the embryo, is always sterile, so that the seeds can easily be disinfected without producing any ill-effects on germination.

Thus the mycorrhizal fungi must grow in the soil, whence they attack the roots. It is obvious that such fungi must be very widespread in soils with a high admixture of humus, since it is here that the mycorrhiza of conifers constantly occur. Probably the number of species capable of forming mycorrhiza is very limited, and the fungi involved are most likely biologically related. This view is supported by the fact that *M. r. silvestris* (α) and (β) have been isolated by the author both in Holland and Sweden. They develop very slowly on plates, the greatest activity being shown by *M. r. silvestris* (α), and appear to have adapted themselves in a remarkable degree to symbiotic conditions. In all probability they also develop very slowly in the soil when not in association with conifer roots.

On the whole, organic compounds appear to be superior to inorganic as a source of nitrogen. Thus *M. r. silvestris* (α) develops best on nucleic acid, *M. r. silvestris* (γ) and *M. r. abietis* on ammonium citrate. Assimilation of atmospheric nitrogen does not occur in pure culture. The fact that nucleic acid constitutes a suitable source of nitrogen for *M. r. silvestris* (α) is of great interest, as it has been isolated from humus by Schreiner and Skinner. This suggests that at any rate certain mycorrhizal fungi are able to assimilate complicated organic nitrogenous compounds from the soil, and to supply the trees with nitrogen in some form. Further experiments on these lines will be undertaken. There is also a possibility that some of the fungi in question can fix the atmospheric nitrogen, for though assimilation of free nitrogen has not been observed in pure culture, it may take place in the symbiotic condition.

In any case, the probable significance of the mycorrhizal fungi

lies in their transmission of nitrogen to the trees. Pine seedlings flourish in pure cultures when supplied with nitrogen in an assimilable form, e. g. sal ammoniac or nitrate.

These fungi do not seem to thrive equally on all natural types of humus. Culture experiments show that mould extracts tend to arrest considerably their development. This would explain the poor development of the mycorrhiza of conifers in mould soils ('Mullboden'). In acid types of humus their development is sometimes good, sometimes poor, and the author proposes to follow up this line of investigation.

Law of May 6, 1921, concerning the export and import of Potatoes from and to Denmark with orders and regulations of September 13 and October 20, 1921, and regulations of October 18, 1921, concerning a Plant Inspection Service. Abbreviated Translation authorized by the Danish Minister of Agriculture, 12 pp., Danish Legation, London, 1921.

The orders concerning the export and import of potatoes of September 13, 1921, came into force on October 1 last. All consignments of potatoes for export must be accompanied by a certificate issued by the 'Committee for examining the commercial quality of potatoes for export', stating that inspection has taken place according to the regulations, and that the consignment has been found fit for export. At least ten days before the inspection, the exporter must notify the committee stating his name and address, name and address of the consignee, name of country of destination, time and place of inspection, number and marks of bags (or number of tons and railway trucks if not bagged), and name of variety.

If the country of destination requires the potatoes to be certified as to freedom from certain diseases, the consignment must also be accompanied by a certificate issued by the 'Committee on contagious diseases of plants' stating that inspection has taken place according to the regulations, no case of wart disease (*Synchytrium endobioticum*) has been found in the part of the country where the potatoes in question were grown, the potatoes are free from wart disease, other injurious diseases of potatoes, or destructive insects, and the consignment is packed in new bags, boxes, barrels, or other receptacles. This committee must be notified in the same way as the committee on quality and receive the following additional details: quantity of potatoes from each grower, with name and address of growers, and the number of permits to import if such permit be required in the country of destination. Notice to the health inspection committee is counted to serve also as notice to the committee on quality.

By an additional order of October 20, the export of potatoes not for food but for industrial purposes may take place without an examination of their commercial quality, but the consignment must be accompanied by a certificate from the above-mentioned committee to that effect.

In the health inspection of the potatoes only those grown in Denmark are to be inspected. At least 5 per cent. of the bags must be examined, the potatoes being turned out and examined

one by one. The inspectors are required to see that the consignment is derived from districts where no wart disease has been found, that certain diseases (at present wart disease) do not exist in the slightest degree, that the potatoes show a satisfactory state of health, that damage by cutting, frost, potato blight (*Phytophthora infestans*) and other decay (*Fusaria, Bacillus phytophthorus* or other bacteria), and scurf is not present in more than 4 per cent. of the potatoes examined (provided that the Chairman may prescribe certain limits for special diseases), that the potatoes have been packed in new bags, boxes, barrels, or other receptacles, and that the exporters have fulfilled in every respect the requirements of the present regulations.

In the inspection for commercial quality the inspectors are required to see that the consignment does not contain more than 2 per cent. of potatoes damaged by frost or rot (*Phytophthora infestans, Fusaria, Bacillus phytophthorus* or other bacteria), that it does not contain more than 5 per cent. of tubers suffering from scurf or damaged by cuts from implements or by larvae or birds, that it does not contain more than 4 per cent. of potatoes with shoots of more than 2 cm. in length, nor more than 4 per cent. of soil, straw, &c., that the potatoes are not covered by soil or dirt, or damp to such an extent that disease and damage to the tubers cannot be seen, that the consignment does not contain more than 5 per cent. of potatoes of a variety differing in shape and colour from that notified to the committee on commercial quality, and that the potatoes are carefully sorted. Excessively large and irregularly-shaped tubers must not be present. Unless otherwise stipulated, potatoes sold to Great Britain and the United States must have a diameter of at least 4·5 cm., and to other countries a diameter of at least 3·5 cm., measured where the diameter of the tuber is shortest. (This does not apply to new potatoes exported before the end of August.) Potatoes for export to Great Britain and the United States must be packed in bags of 51 and 75 kg. respectively, unless otherwise stipulated. The total of the abovenamed detractions from the quality must not exceed 6 per cent. In the export of potatoes for industrial purposes without an examination, the exporter must prove before the committee that the potatoes are sold for such purposes, by means of a declaration and a statement from the purchasers abroad that they have bought the consignment to be industrially treated in a factory. A permit for import must be produced, if required by the country of destination.

As regards the import of potatoes the regulations provide that potatoes may only be imported into Denmark on condition that the consignment is accompanied by a certificate issued by a recognized service of plant inspection in the country of origin, that the potatoes are packed in new bags, boxes, barrels, or other receptacles, sealed by the said service of plant inspection, and that the consignment on arrival in Denmark is examined by the committee on contagious diseases of plants, a certificate from which must be handed to the customs, stating that the committee is of opinion that the consignment is free from wart disease (*Synchytrium endobioticum*), and fulfils in all respects the conditions for the import of potatoes into Denmark specified in the regulations.

The certificate from abroad must be attached to the invoice, and must be issued within a month before the shipment of potatoes from the country of origin by a recognized service of plant inspection, and contain the names and addresses of consignor and consignee, and the name of the country and district of origin. The certificate must state that the potatoes in the consignment have been grown in a district free from wart disease, and are free from wart disease, other injurious diseases and destructive insects, and that the consignment is packed in new bags, boxes, barrels, or other receptacles, sealed by the service of plant inspection. At least ten days before the inspection in Denmark, the importer must notify the above-named committee, stating the quantity of potatoes, probable date of shipment, name and address of exporter, name of country of origin, port of shipment, port or place of entry (Customs), and name and address of receiver.

All expenses connected with the inspection must be paid to the committee by the importer.

In inspecting the consignment the inspectors will be required to see that the certificate from abroad is as prescribed; particularly that certain injurious diseases (at present wart disease) are not present even in the slightest degree. The potatoes generally must show a satisfactory state of health; damage by cutting, frost, potato blight (*Phytophthora infestans*) or other decay (*Fusaria*, *Bacillus phytophthorus* or other bacteria), and scurf not being present in more than 4 per cent. of the potatoes examined (provided that the Chairman may prescribe certain limits for special diseases). The potatoes must have been packed in new bags, boxes, barrels, or other receptacles, closed with the seal of the service of plant inspection abroad. In general, inspectors must satisfy themselves that the importers have fulfilled in every way the requirements of the present regulations.

By regulations of October 18, 1921, a Plant Inspection Service to control the health of live plants and parts of plants to be exported from Denmark has been established under the control of the committee on contagious diseases of plants appointed by the Minister of Agriculture. These regulations extend the inspection of plants, intended for export to countries requiring health certificates, to other plants than potatoes.

The regulations with regard to notice of intention to export and particulars to be furnished to the committee are similar to those laid down in the previous orders (which dealt only with potatoes). It will be noticed that whereas the inspection of potatoes for export and import is compulsory, that of other plants for export is voluntary.

Only such live plants and parts of plants shall be inspected as, according to a declaration in writing, have been produced in Denmark or grown in Danish soil for not less than twelve months.

Inspection of consignments of plants shall take place only if they are derived from plantations which, by an investigation during the time of growth, have been found free from such destructive insects and injurious diseases of plants as can be conveyed by means of the plants. Notice of such investigation must be given to the committee before July 1, and an inspection of consignments must

be carried out immediately prior to export, the exporters arranging to transport the consignments to the place of inspection. When both the consignment and the plantations from which it is derived have been found free from destructive insects and injurious diseases of plants, the committee shall issue a certificate in the form prescribed by the country of destination, and shall seal the packages with lead seals.

Einfuhrkontrolle der Kartoffeln in Schweden und Dänemark (Kartoffelkrebs). [Control of Potato-imports in Sweden and Denmark (Wart disease).]—*Nachrichtenblatt für den deutschen Pflanzenschutzdienst*, i, 6, pp. 55–56, 1921.

A Royal Decree issued on September 12, 1921, concerning the import of potatoes into Sweden, came into force on October 1, 1921. It is thereby enacted that the import of potatoes by land or sea shall take place only under the following conditions:

1. That the potatoes are accompanied by a certificate of health, issued by an official expert of the exporting country not longer than thirty days before the date of export. The *bona fides* of this expert must be attested by the Swedish Legation or a Swedish consulate in the exporting country.

2. That the potatoes are dispatched in sacks, barrels, cases, or other packing material.

The certificate of health shall contain the following particulars:

(*a*) Names and addresses of the sender and the addressee.

(*b*) Place of origin of the potatoes.

(*c*) A statement to the effect that the potatoes are free from canker (wart disease).

(*d*) A statement to the effect that potato canker or wart disease (*Synchytrium endobioticum*) is not known to occur in the country of origin, or that it has not been known for the last six years before the issue of the certificate.

(*e*) A statement that the packing material has not been used before.

(*f*) The seal of the official issuing the certificate to be affixed to the packing cases.

(*g*) A statement of the official position of the person issuing the certificate.

[For the Danish regulations see the last abstract.]

DRECHSLER (C.). **Occurrence of Rhyncosporium on Dactylis glomerata and Bromus inermis.**—Abs. in *Phytopath.*, xi, 1, p. 42, 1921.

Rhyncosporium secalis (Oud.) Davis was found to be as abundant on *Bromus inermis* as on rye and barley at Madison, Wisconsin, in 1920. It was also found on *Dactylis glomerata*, but less commonly.